Topics for the EECE-565 Qualifying Exam: Chapters 1, 2, 3, 4, 5, 6, and 8 of the text by G. Agrawal (Fiber-Optic Communication Systems)

Basics Concepts in Digital Communication (Ch. 1)

- Digital formatting of analog electrical signals: Sampling, quantization, pulse-code-modulation strategies (e.g., on-off keying, RZ vs. NRZ), bandwidth requirements.
- Frequency-domain and time-domain multiplexing of signals: limiting factors.

Optical Fibers (Ch. 2)

- Step- and graded-index fibers; modal and material dispersion,
- Fiber modes, single-mode fibers
- Group-velocity dispersion
- Polarization-mode dispersion
- Fiber losses

Sources (Ch. 3)

- Types of transmitters: LEDs, Semiconductor lasers.
- Laser threshold and efficiency
- Bandwidth.
- Examples of transmitter design.

Photodetectors and Receiver (Ch. 4)

- Key sub-components of an optical receiver
- Front-end configurations, trade-off between trans-impedance and trans-resistance.
- Principle of photodetection in semiconductors, the photoelectric effect
- The PIN detector, responsivity, dark current, and quantum efficiency.
- Photocurrent and its attributes (interplay between rise time, bandwidth, depletion-layer width and carrier velocity)
- APDs: Principle of operation, calculation of the multiplication factor; advantages and disadvantages of avalanche gain, when is it needed?.
- What is meant by a “linear channel?” Strategies to mitigate ISI.
- Noise in PIN and APD photodetectors; fundamental limits of SNR
- Receiver sensitivity and the factors that affect it: receiver bandwidth, type of photodetector used (and the noise therein), role of gain and its optimization, non-extinction, intensity-noise calculation using the RIN, jitter.

System Architecture and Design (Ch. 5)

- LAN, point-to-point, and broadcast networks
- Loss-limited and dispersion-limited systems
- Power and rise-time budget calculations

Optical amplifiers (Ch. 6)

- Semiconductor amplifiers.
- Erbium-doped fiber amplifiers.
- Raman amplifiers.
- Applications.

Multi-channel systems (Ch. 8)

- Wavelength-division multiplexing (WDM): systems and components.
- Time-division multiplexing (TDM).